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U. S. Nuclear Regulatory Commission
Document Control Desk
Mail Station OP1-17
Washington, DC 20555

Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
ANO-1 Cycle 18 COLR

Dear Sir or Madam:

Arkansas Nuclear One – Unit 1 (ANO-1) Technical Specification 5.6.5 requires the submittal of the Core Operating Limits Report (COLR) for each reload cycle. Attached is Revision 0 of the ANO-1 Cycle 18 COLR. Please note that the approved revision number of the Babcock and Wilcox Topical Report BAW-10179P-A is identified in the COLR as August 2001. This completes the reporting requirement for the referenced specification. This submittal contains no commitments. Should you have any questions, please contact David Bice at 479-858-5338

Sincerely,

Sherrie R. Cotton

Sherrie R. Cotton
Director, Nuclear Safety Assurance

SRC/dbb
Attachment: ANO-1 Cycle 18 Core Operating Limits Report (COLR)

A001

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Attachment

ANO-1 Cycle 18 Core Operating Limits Report (COLR)

ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE
UNIT ONE

CYCLE 18

CORE OPERATING LIMITS REPORT

1.0 CORE OPERATING LIMITS

This Core Operating Limits Report for ANO-1 Cycle 18 has been prepared in accordance with the requirements of Technical Specification 5.6.5. The core operating limits have been developed using the methodology provided in the reference.

The following cycle-specific core operating limits are included in this report:

1) 2.1.1 Variable Low RCS Pressure – Temperature Protective Limits,
2) 3.1.1 SHUTDOWN MARGIN (SDM),
3) 3.1.8 PHYSICS TESTS Exceptions – MODE 1,
4) 3.1.9 PHYSICS TEST Exceptions – MODE 2,
5) 3.2.1 Regulating Rod Insertion Limits,
6) 3.2.2 AXIAL POWER SHAPING RODS (APSR) Insertion Limits,
7) 3.2.3 AXIAL POWER IMBALANCE Operating Limits,
8) 3.2.4 QUADRANT POWER TILT (QPT),
9) 3.2.5 Power Peaking,
10) 3.3.1 Reactor Protection System (RPS) Instrumentation,
11) 3.4.1 RCS Pressure, Temperature, and Flow DNB limits,
12) 3.4.4 RCS Loops – MODES 1 and 2, and
13) 3.9.1 Boron Concentration.

2.0 REFERENCES

1. "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis," BAW-10179P-A, Rev. 4, Framatome ANP, Lynchburg, Virginia, August 2001.
2. Letter dated 4/9/02 from L W. Barnett USNRC to J.M. Mallay FRA-ANP, "Safety Evaluation of Framatome Technologies Topical Report BAW-10164P Revision 4, 'RELAP5/MOD2- B&W, An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis' (TAC Nos MA8465 and MA8468)," USNRC ADAMS Accession Number ML013390204.
3. RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA Transient Analysis, BAW-10164P, Rev. 4, Framatome Technologies, Inc., Lynchburg, Virginia, September 1999.
4. "Qualification of Reactor Physics Methods for the Pressurized Water Reactors of the Entergy System," ENEAD-01-P, Rev. 0, Entergy Operations, Inc., Jackson, Mississippi, December 1993.

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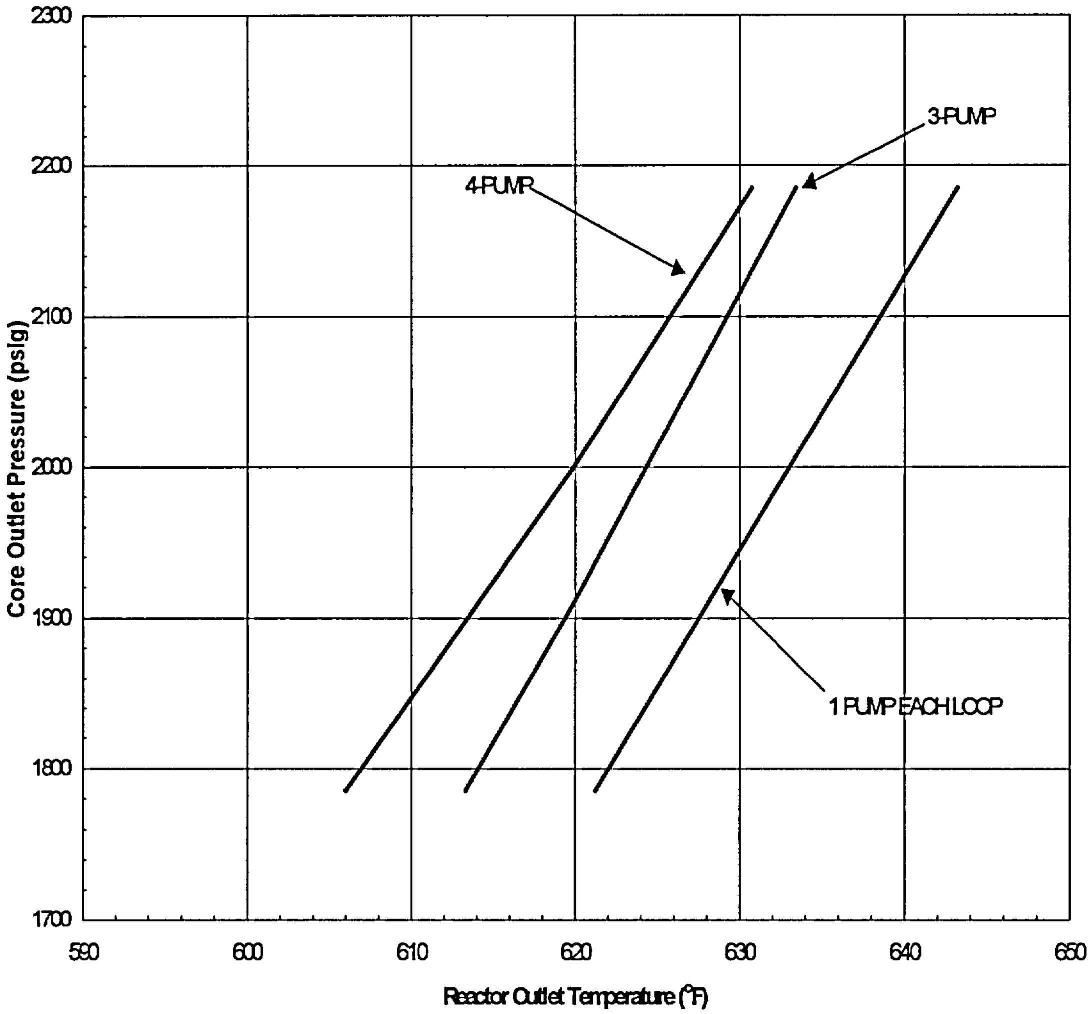
**Figure is referred to by
Technical Specification 2.1.1.3**

Figure 1. Variable Low RCS Pressure--Temperature Protective Limits

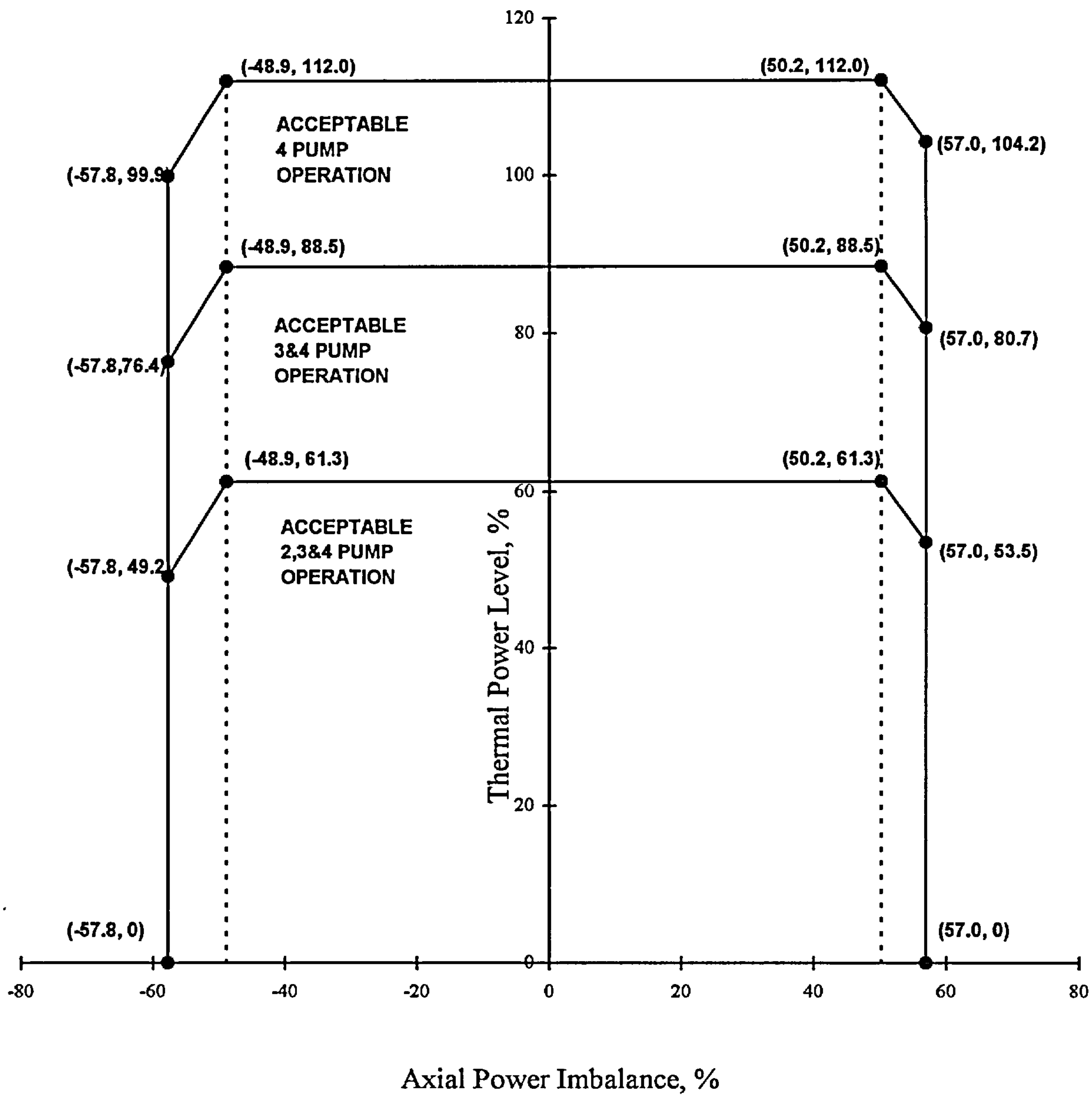


PUMPS OPERATING (TYPE OF LIMIT)	GPM*	POWER**
Four Pumps (DNBR Limit)	369,600 (100%)	110%
Three Pumps (DNBR Limit)	276,091 (74.7%)	89%
One Pump in Each Loop (DNBR Limit)	181,104 (49%)	62.2%

* 105% of Design Flow (2.5% UNCERTAINTY INCLUDED IN STATISTICAL DESIGN LIMIT)
**AN ADDITIONAL 2% POWER UNCERTAINTY IS INCLUDED IN STATISTICAL DESIGN LIMIT

Figure is referred to by Technical Specification 2.1.1 Bases

Figure 2. AXIAL POWER IMBALANCE Protective Limits (measurement system independent)



**LIMITS ARE REFERRED TO BY
TECHNICAL SPECIFICATIONS 3.1.1, 3.1.4, 3.1.5, 3.1.8, 3.1.9, AND 3.3.9**

SHUTDOWN MARGIN (SDM)

Verify SHUTDOWN MARGIN per the table below.

APPLICABILITY	REQUIRED SHUTDOWN MARGIN	TECHNICAL SPECIFICATION REFERENCE
MODE 1	≥ 1 %Δk/k	3.1.4, 3.1.5
MODE 2	≥ 1 %Δk/k	3.1.4, 3.1.5, 3.3.9
MODE 3*	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 4*	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 5*	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 1 PHYSICS TESTS Exceptions*	≥ 1 %Δk/k	3.1.8
MODE 2 PHYSICS TESTS Exceptions	≥ 1 %Δk/k	3.1.9

*Requires actual shutdown margin to be ≥ 1 %Δk/k.

Figure is referred to by Technical Specification 3.2.1

Figure 3-A. Regulating Rod Insertion Limits for Four-Pump Operation From 0 to 200 ± 10 EFPD

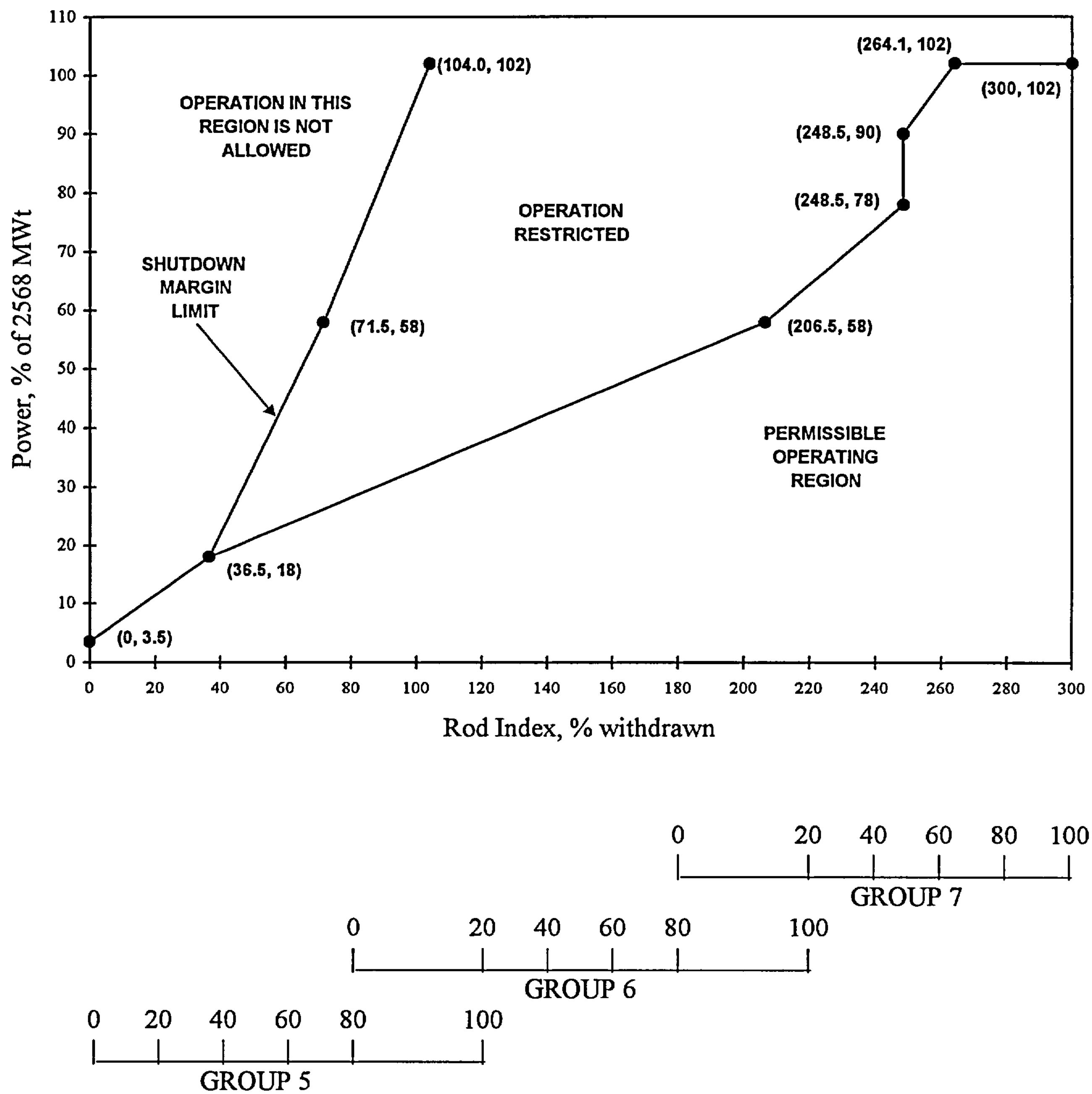


Figure is referred to by
Technical Specification 3.2.1

Figure 3-B. Regulating Rod Insertion Limits for Four-Pump Operation From 200 ± 10 EFPD to EOC

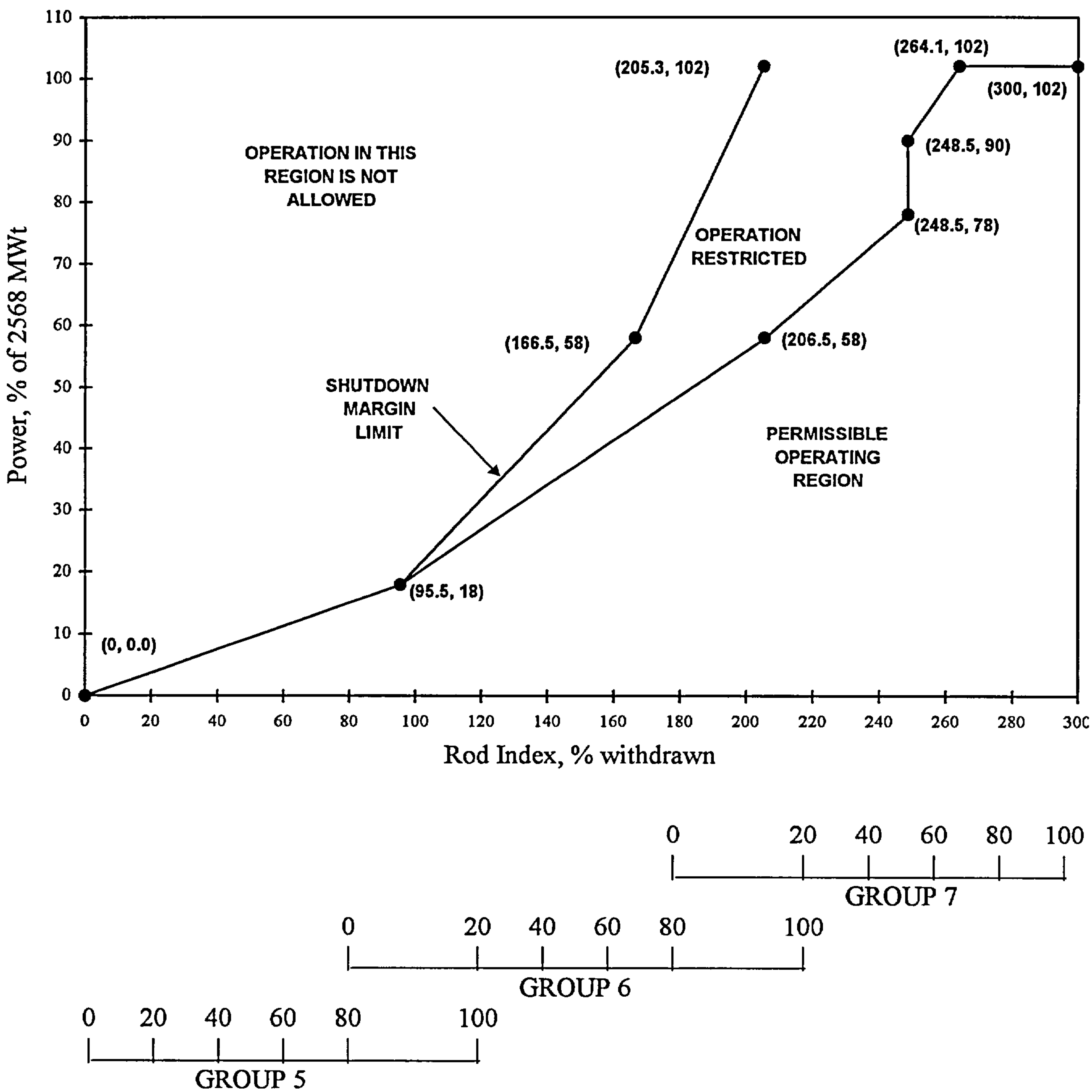


**Figure is referred to by
Technical Specification 3.2.1**

Figure 4-A. Regulating Rod Insertion Limits for Three-Pump Operation From 0 to 200 ± 10 EFPD

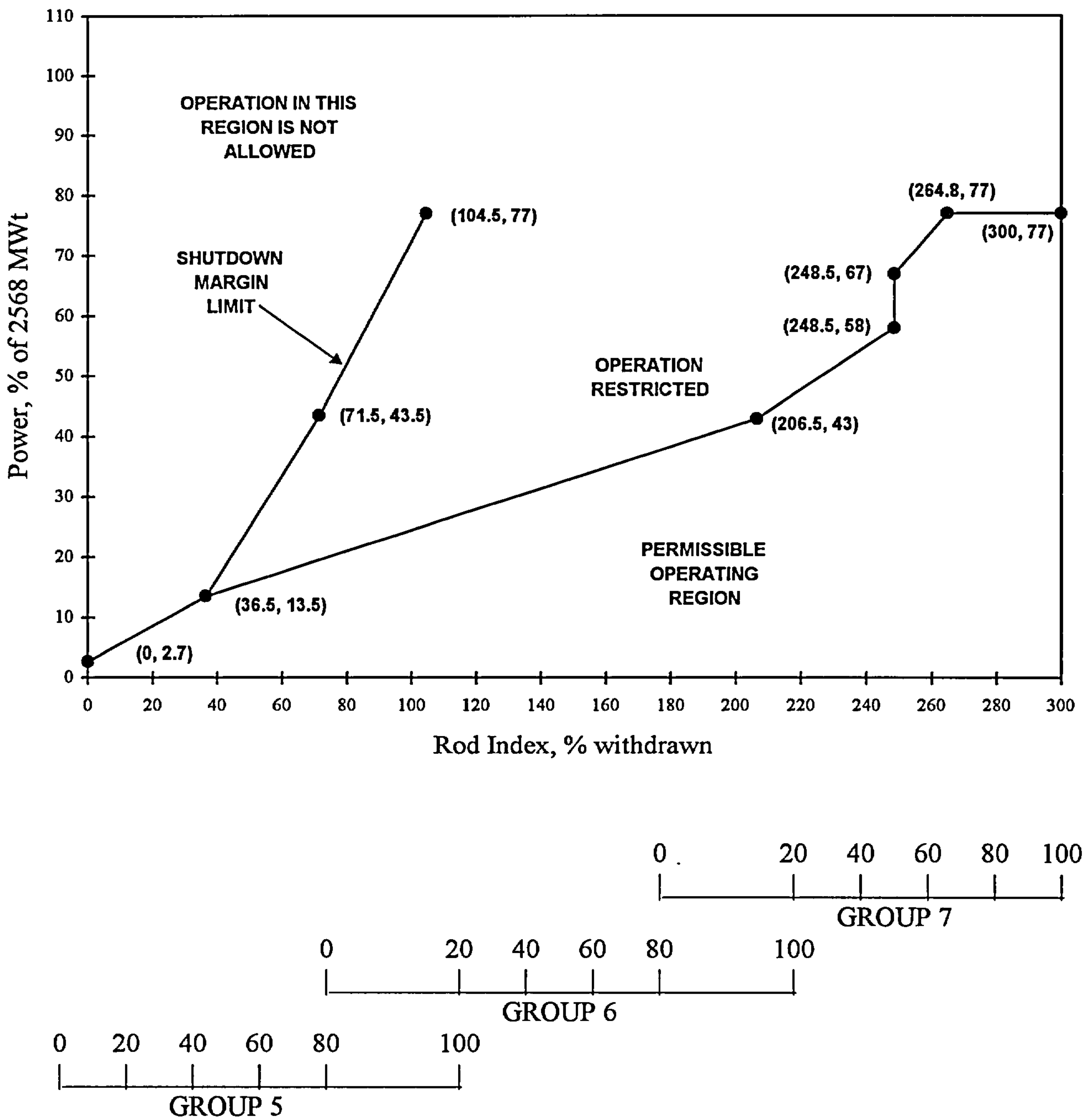


Figure is referred to by
Technical Specification 3.2.1

Figure 4-B. Regulating Rod Insertion Limits for Three-Pump Operation From 200 ± 10 EFPD to EOC

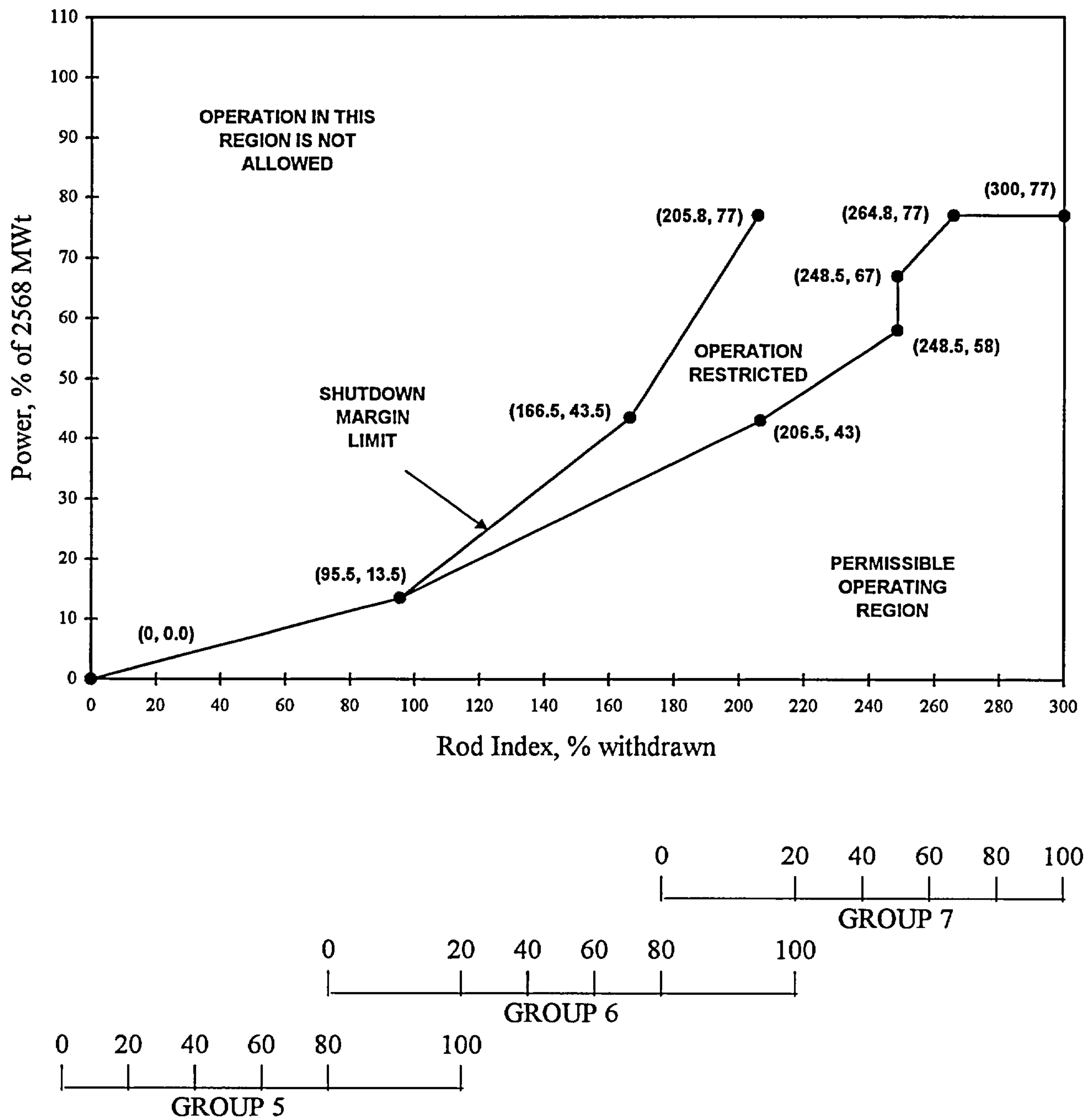


Figure is referred to by
Technical Specification 3.2.1

Figure 5-A. Regulating Rod Insertion Limits for Two-Pump Operation From 0 to 200 ± 10 EFPD

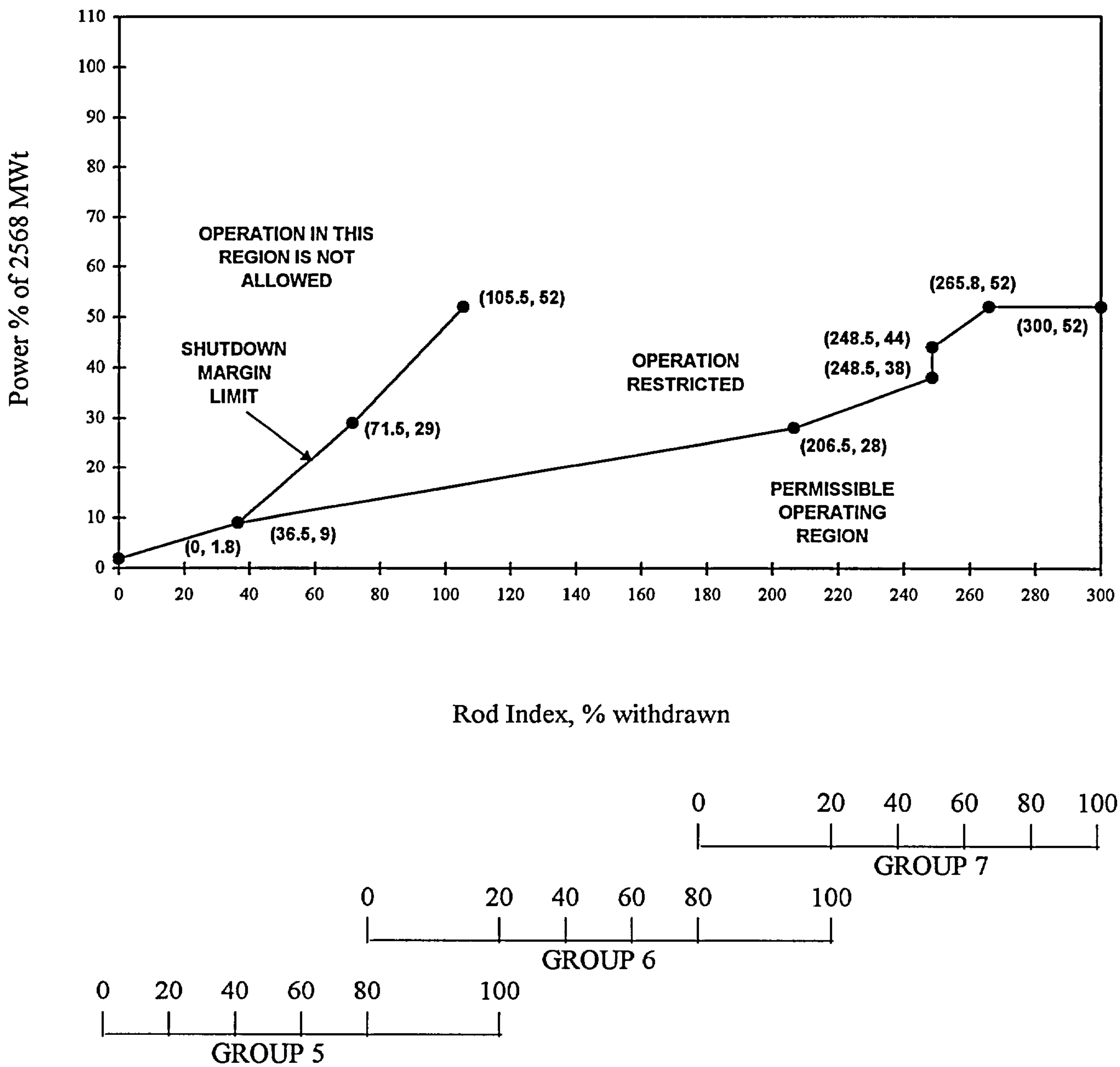
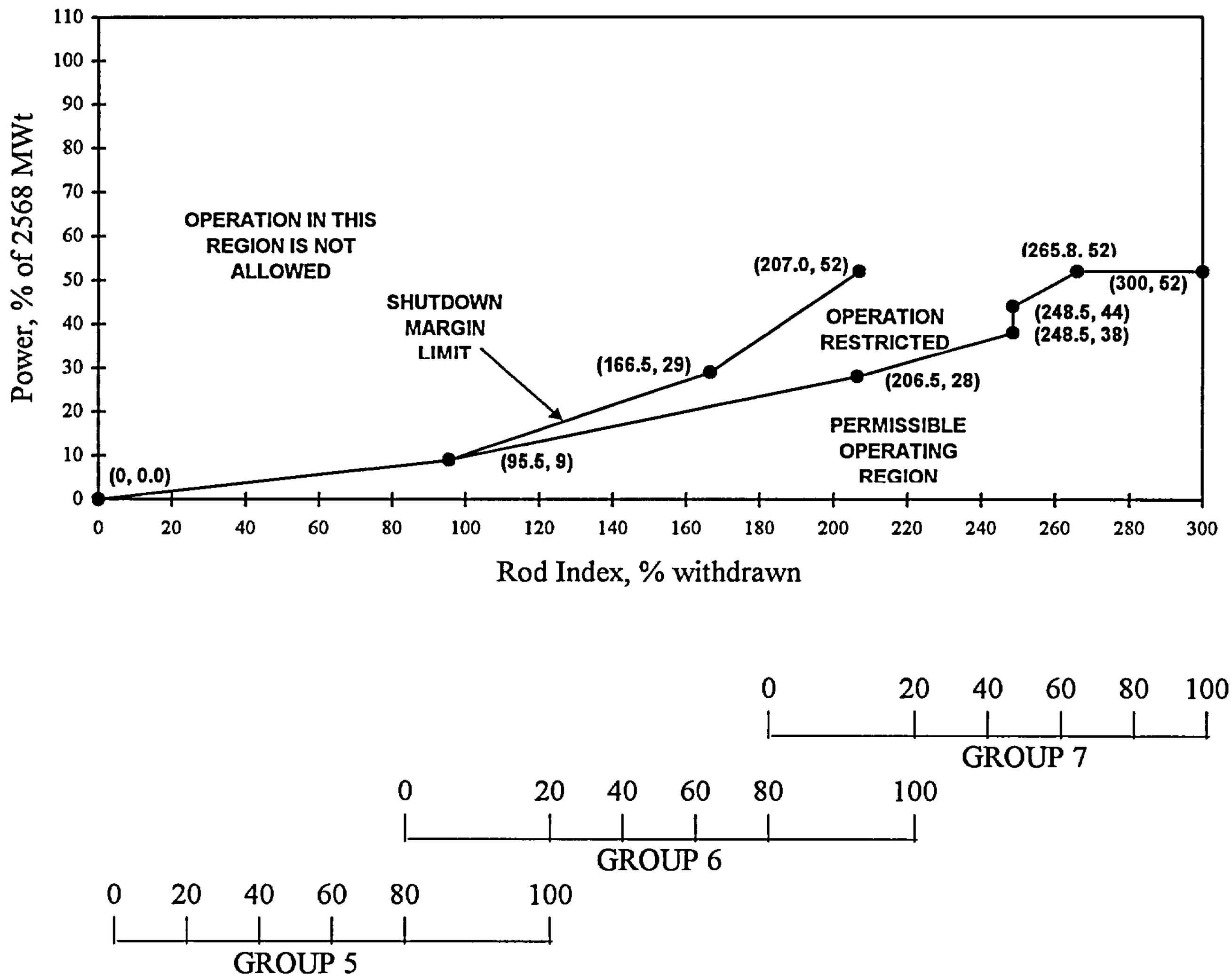


Figure is referred to by Technical Specification 3.2.1

Figure 5-B. Regulating Rod Insertion Limits for Two-Pump Operation From 200 ± 10 EFPD to EOC



LIMITS ARE REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

AXIAL POWER SHAPING RODS (APSR) Insertion Limits

Up to 470 ± 10 EFPD, the APSRs may be positioned as necessary for transient imbalance control, however, the APSRs shall be fully withdrawn by 480 EFPD. After the APSR withdrawal at 470 ± 10 EFPD, the APSRs shall not be reinserted.

Figure is referred to by Technical Specification 3.2.3

Figure 6-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation

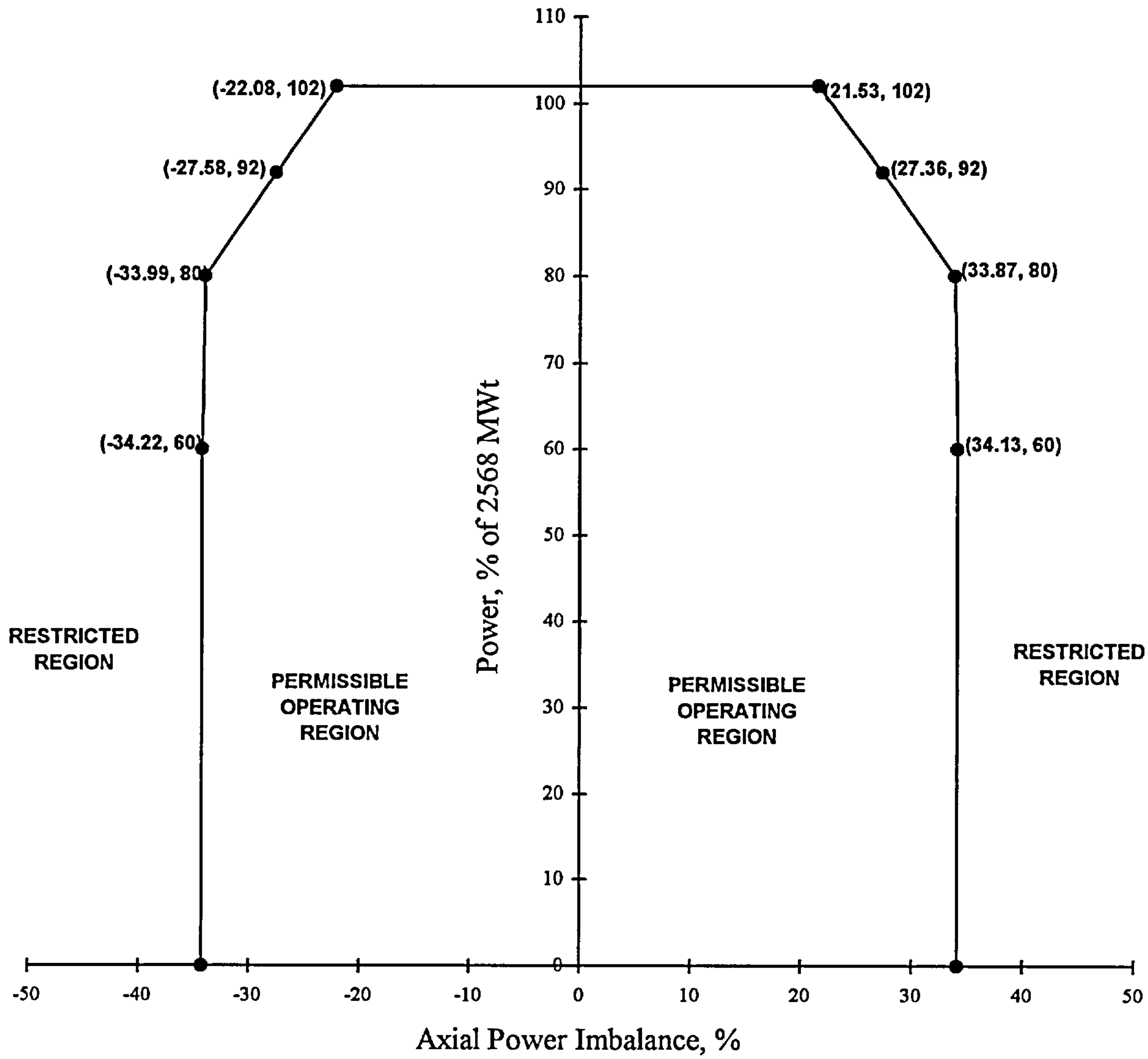
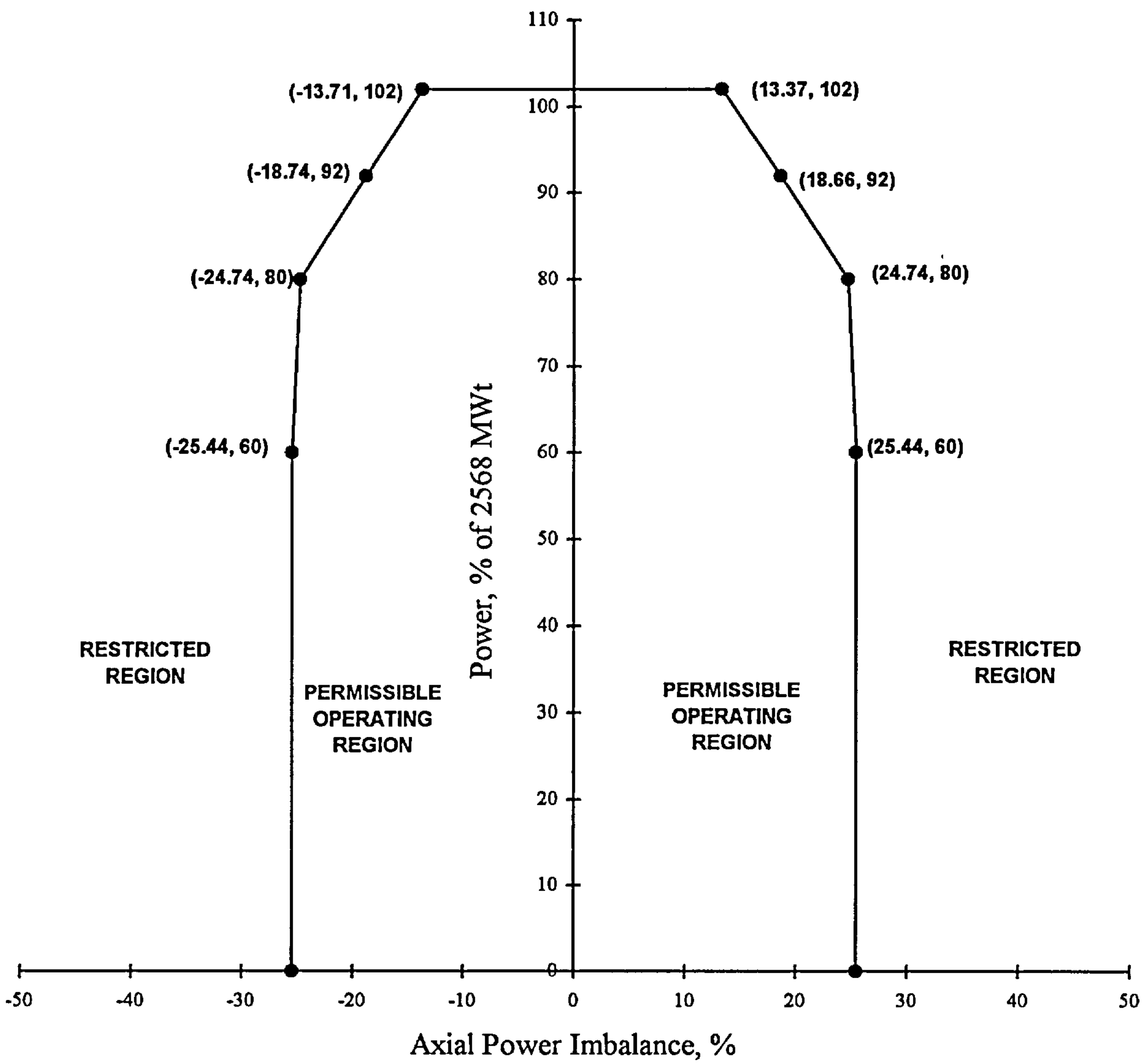


**Figure is referred to by
Technical Specification 3.2.3**

Figure 6-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation



* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both. The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid.

Figure is referred to by
Technical Specification 3.2.3

Figure 6-C. AXIAL POWER IMBALANCE Setpoints for Excore Conditions for Four-Pump Operation

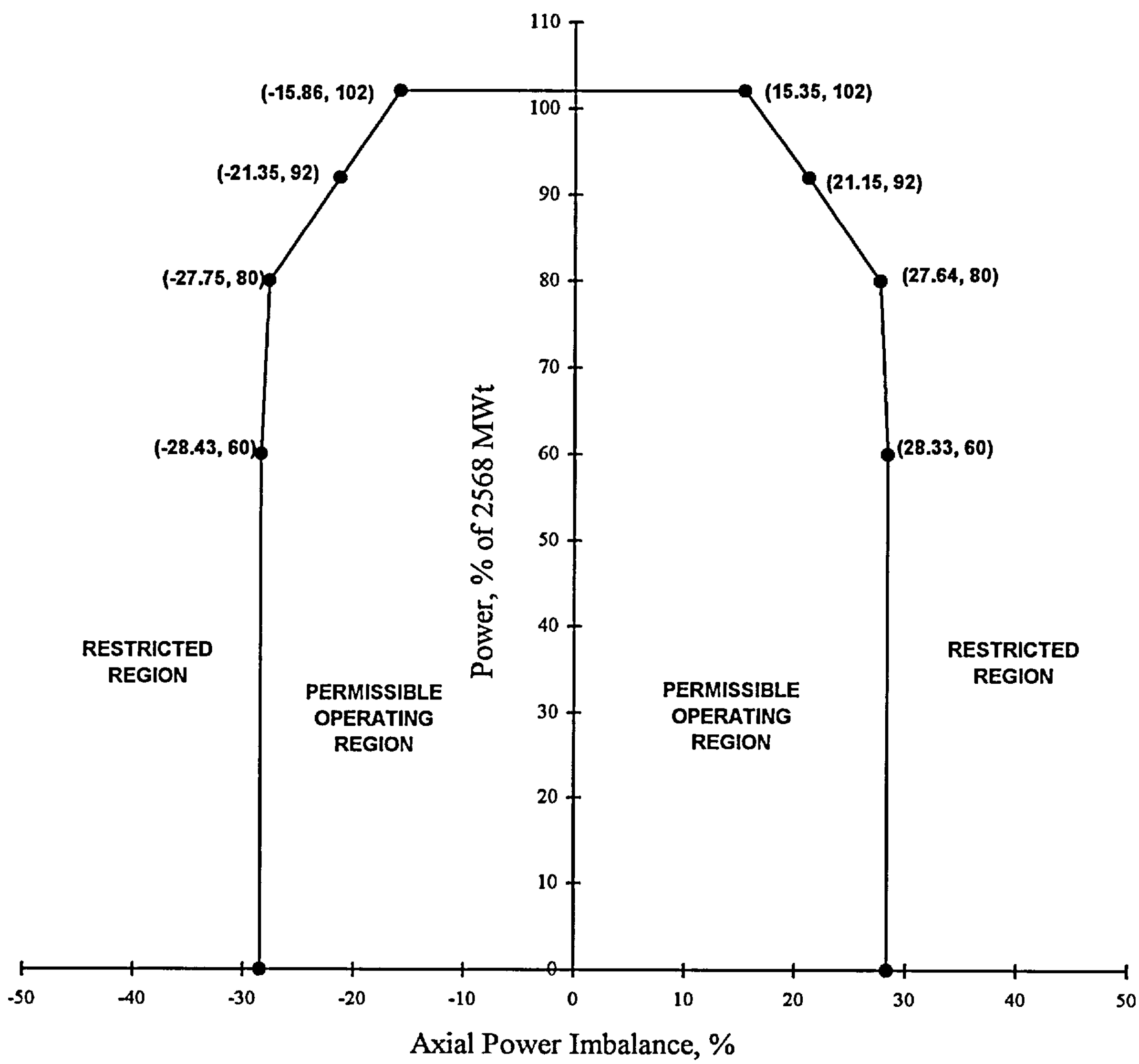


Figure is referred to by
Technical Specification 3.2.3

Figure 7-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation

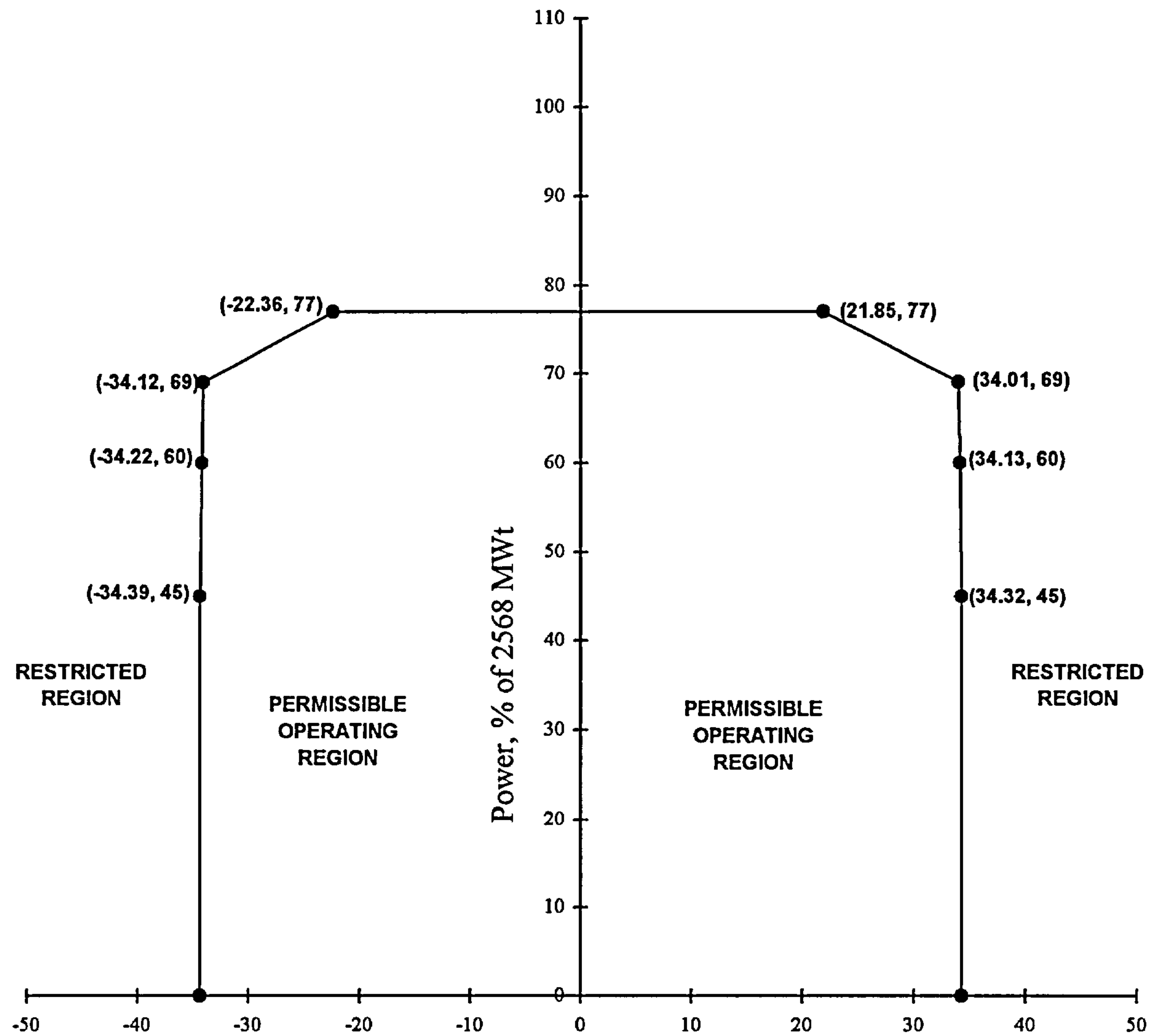
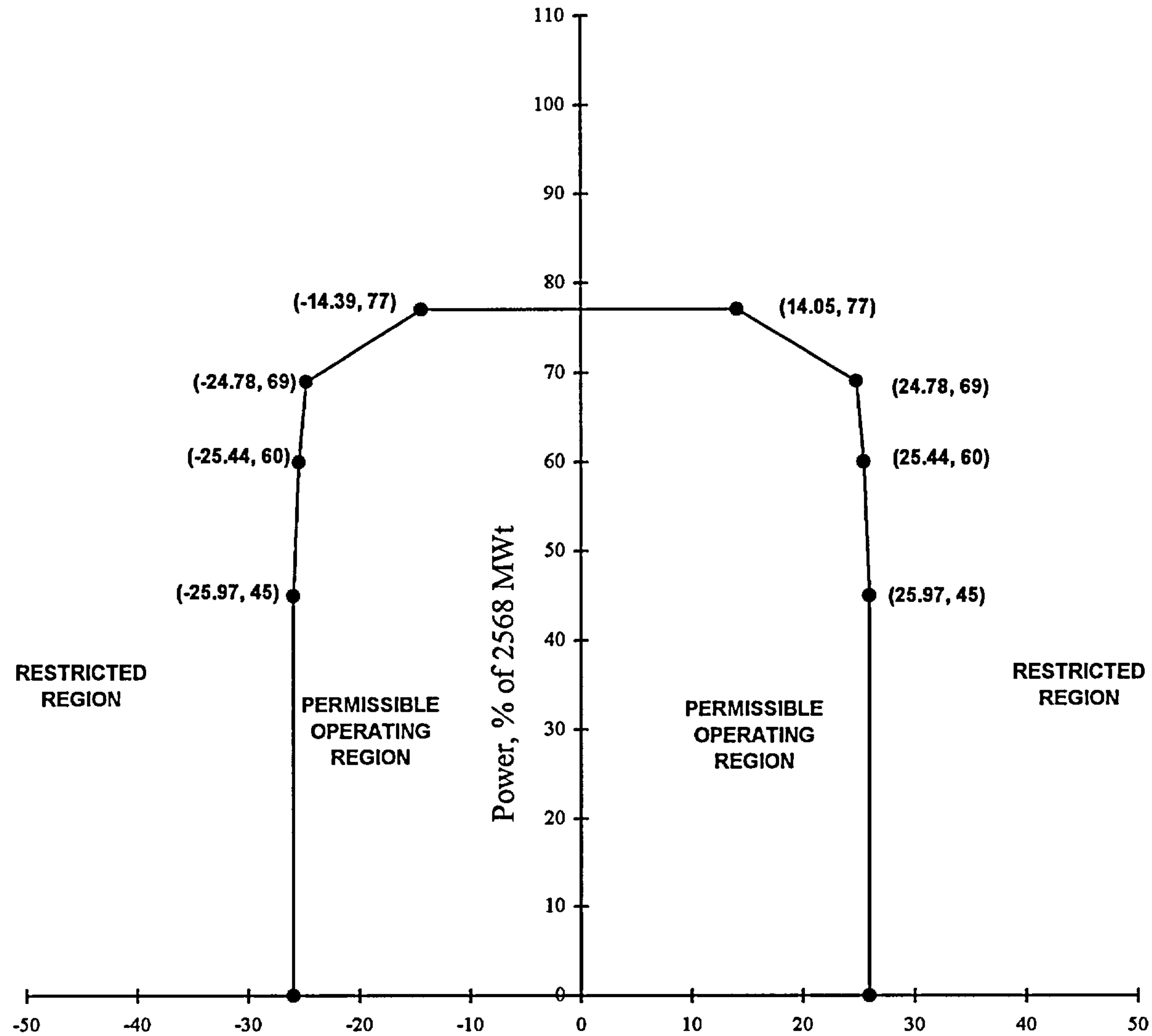


Figure is referred to by Technical Specification 3.2.3

Figure 7-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation



* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both. The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid

Figure is referred to by
Technical Specification 3.2.3

Figure 7-C. AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation

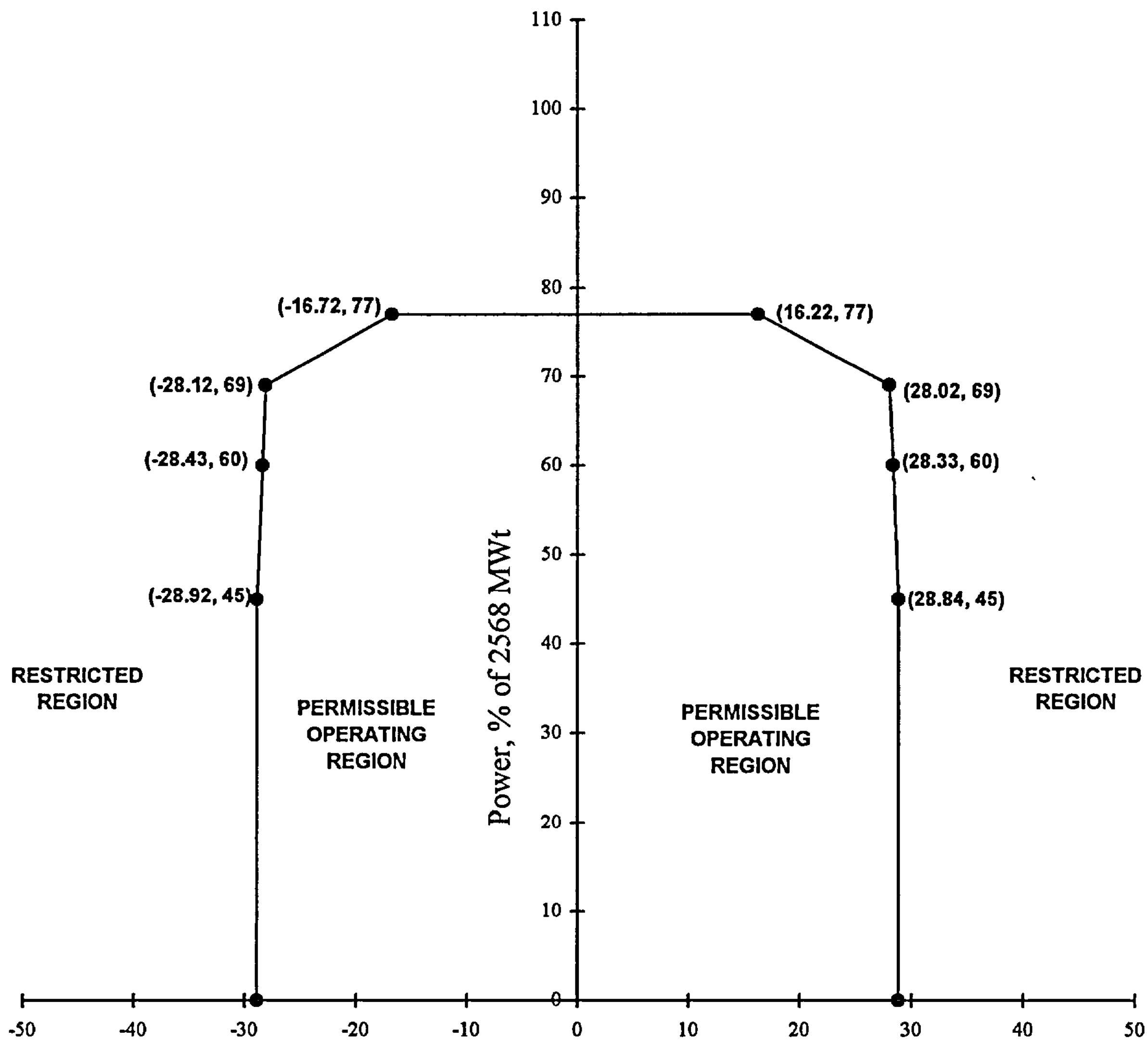


Figure is referred to by
Technical Specification 3.2.3

Figure 8-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Two-Pump Operation

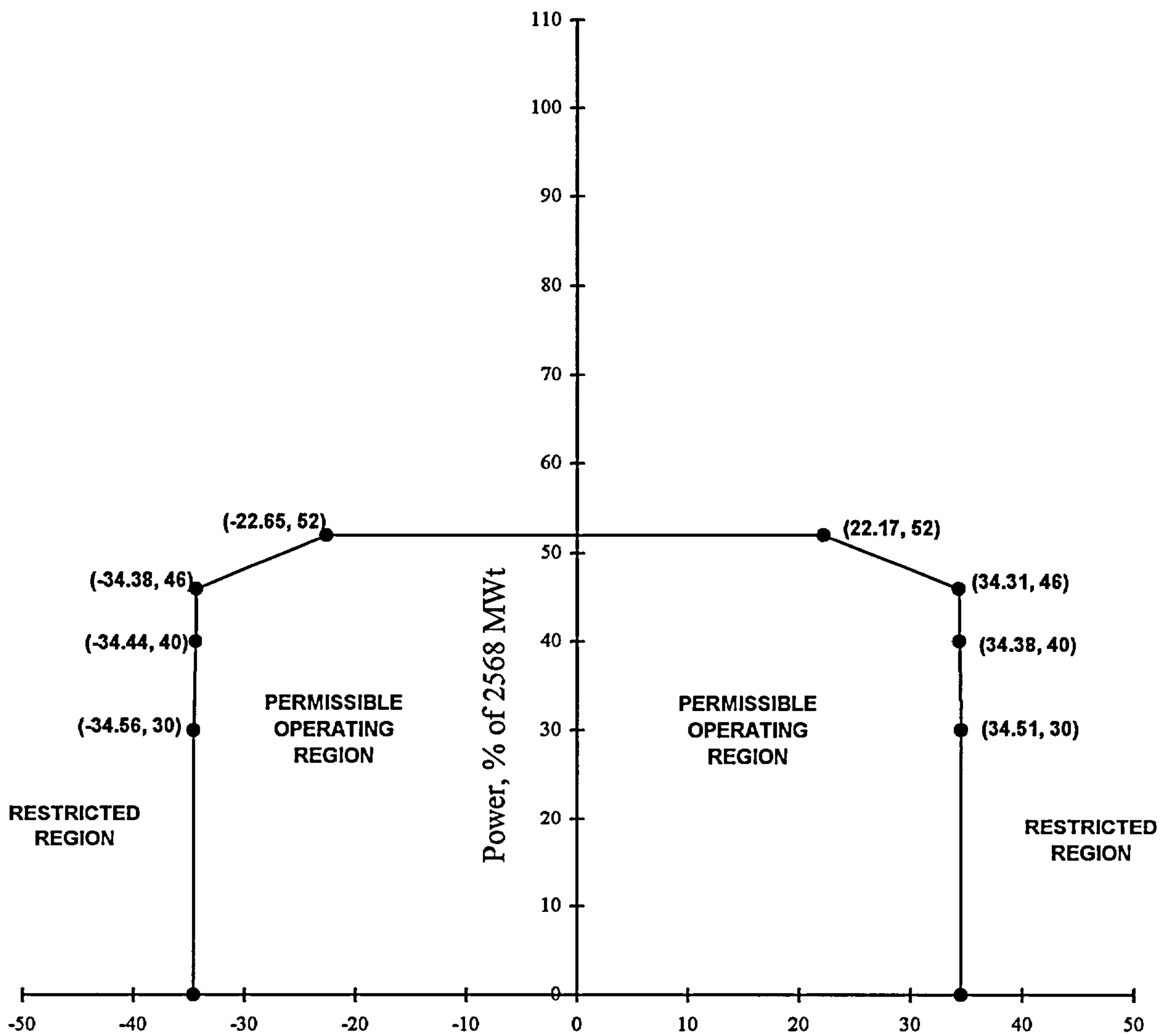
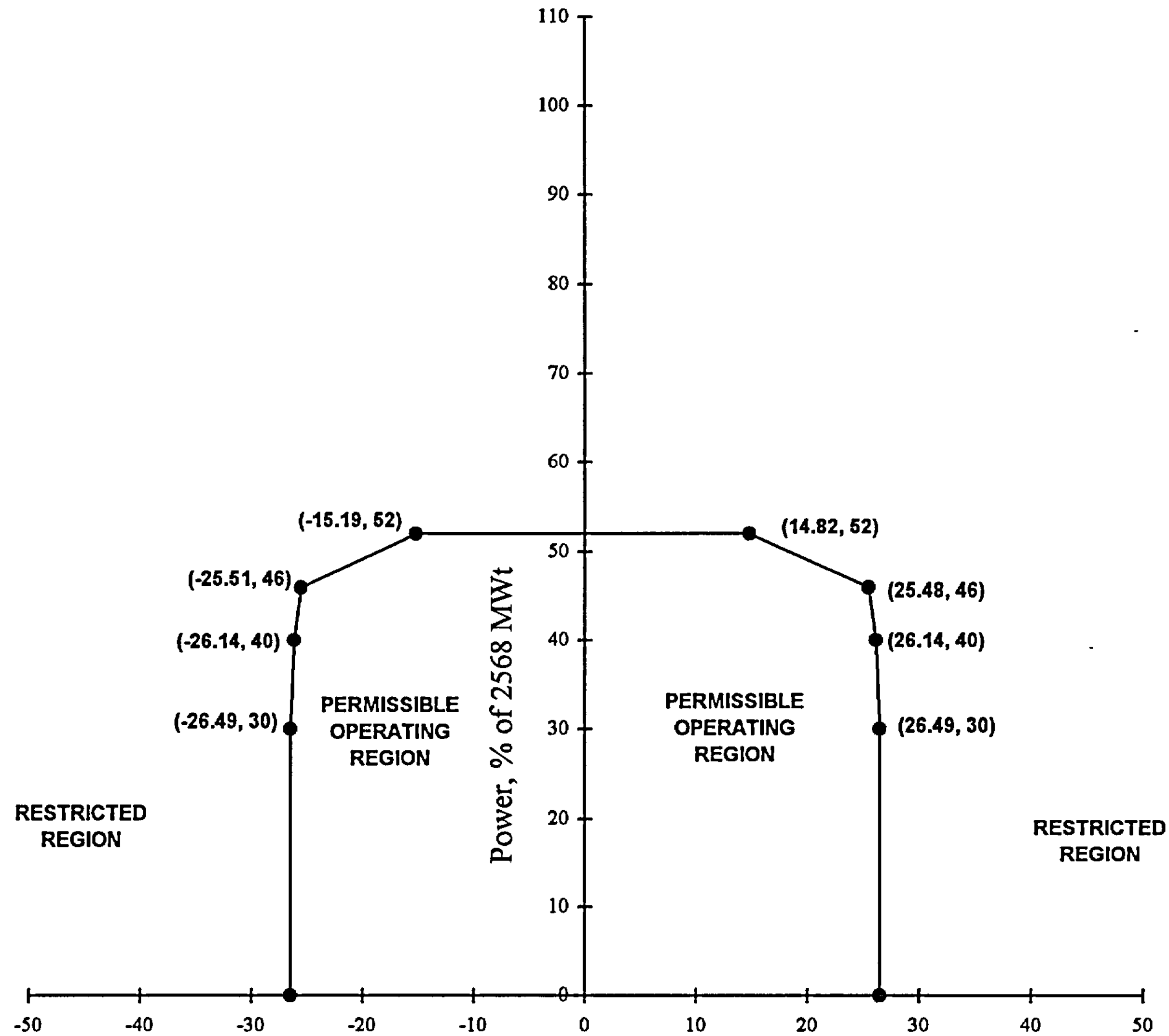


Figure is referred to by Technical Specification 3.2.3

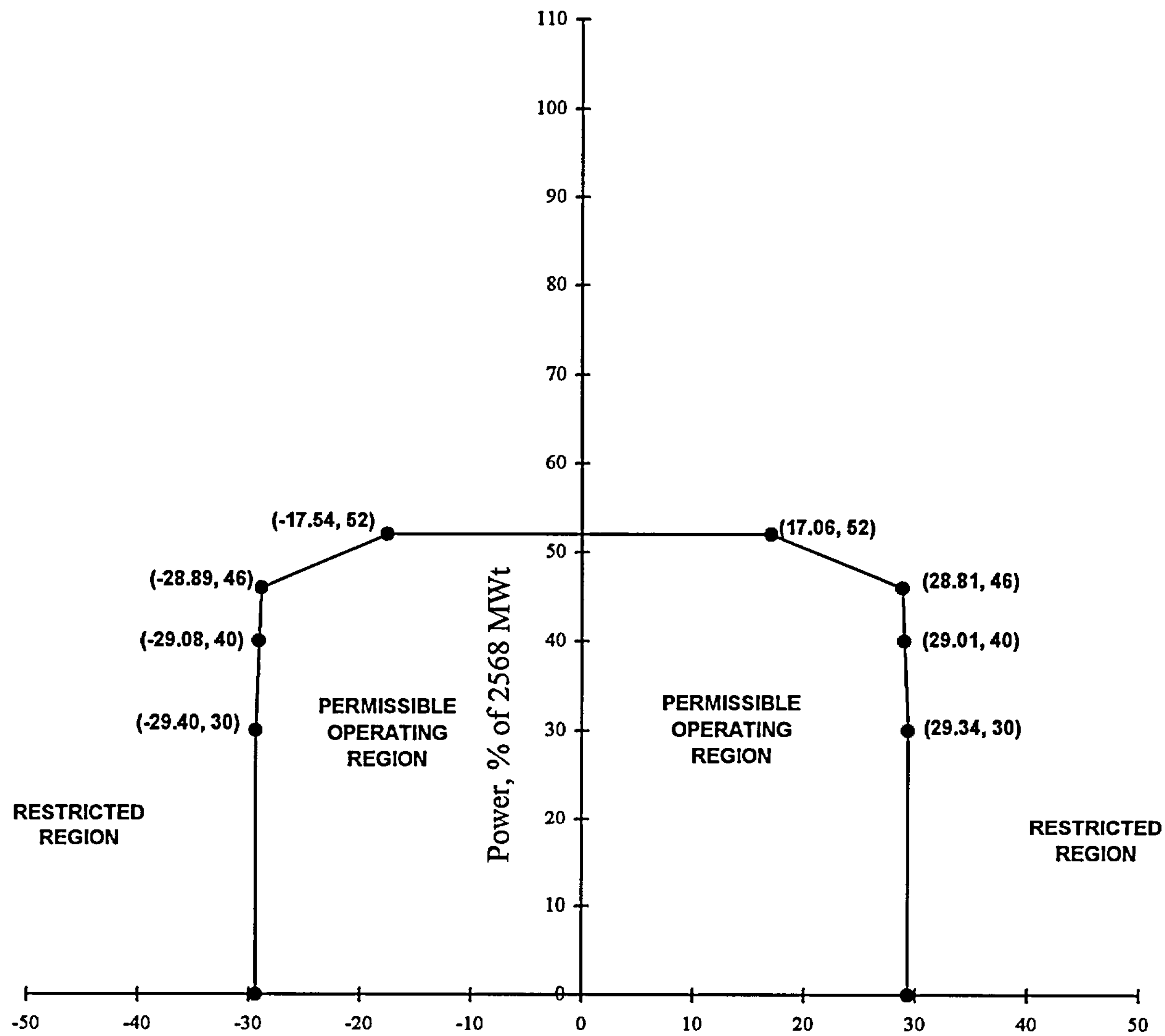
Figure 8-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Two-Pump Operation



* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid.

**Figure is referred to by
Technical Specification 3.2.3**

Figure 8-C. AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Two-Pump Operation



LIMITS ARE REFERRED TO BY TECHNICAL SPECIFICATION 3.2.4

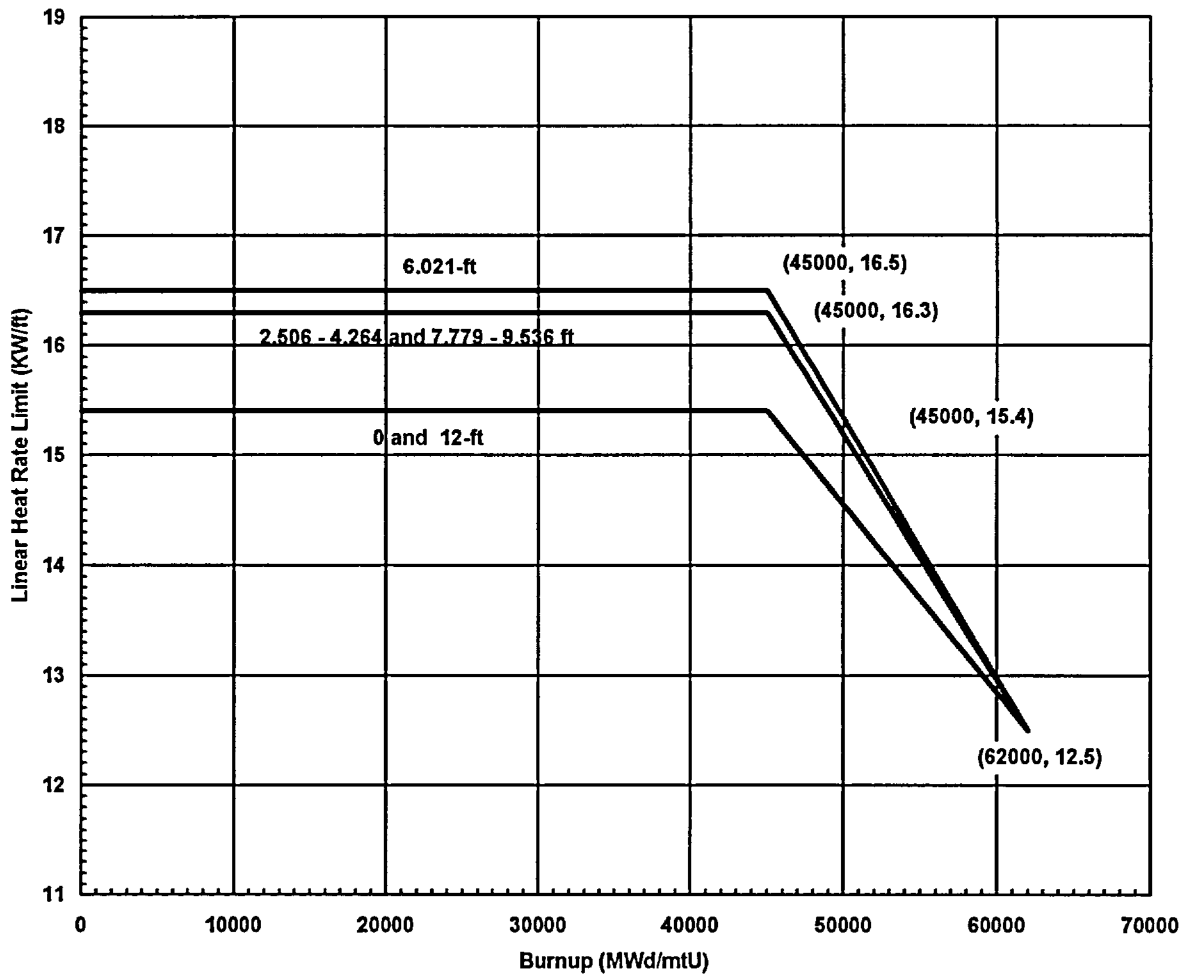
Quadrant Power Tilt Limits And Setpoints

Measurement System	From 0 EFPD to EOC Steady State Value (%) ≤60 % RTP	From 0 EFPD to EOC Steady State Value (%) >60 % RTP	Maximum Value (%)
Full In-core Detector System Setpoint	6.83	4.44	25.0
Minimum In-core Detector System Setpoint	2.78*	1.90*	25.0
Ex-core Power Range NI Channel Setpoint	4.05	1.96	25.0
Measurement System Independent Limit	7.50	4.92	25.0

* Assumes that no individual long emitter detector affecting the minimum in-core tilt calculation exceeds 73% sensitivity depletion. The setpoint must be reduced to 1.50% (power levels >60% FP) and to 2.19% (power levels ≤60% FP) at the earliest time-in-life that this assumption is no longer valid.

Figure is referred to by
Technical Specification 3.1.8 and 3.2.5

Figure 9. LOCA Linear Heat Rate Limits



LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.1.8 and 3.2.5

DNB Power Peaking Factors

The following total power peaking factors define the Maximum Allowable Peaking (MAP) limits to protect the initial conditions assumed in the DNB Loss of Flow transient analysis

		Total Peak	
Axial Peak	**Axial Peak Location X/L**	**4 - Pump Operation**	**3 - Pump Operation**
1.1	0.2	2.028	2.028
1.1	0.4	2.021	2.021
1.1	0.6	2.008	2.008
1.1	0.8	1.985	1.985
1.3	0.2	2.515	2.515
1.3	0.4	2.486	2.486
1.3	0.6	2.411	2.411
1.3	0.8	2.252	2.252
1.5	0.2	2.973	2.973
1.5	0.4	2.786	2.786
1.5	0.6	2.596	2.596
1.5	0.8	2.422	2.422
1.7	0.2	3.117	3.117
1.7	0.4	2.921	2.921
1.7	0.6	2.727	2.727
1.7	0.8	2.560	2.560
1.9	0.2	3.237	3.237
1.9	0.4	3.024	3.024
1.9	0.6	2.841	2.841
1.9	0.8	2.675	2.675

Note - the values above have not been error corrected

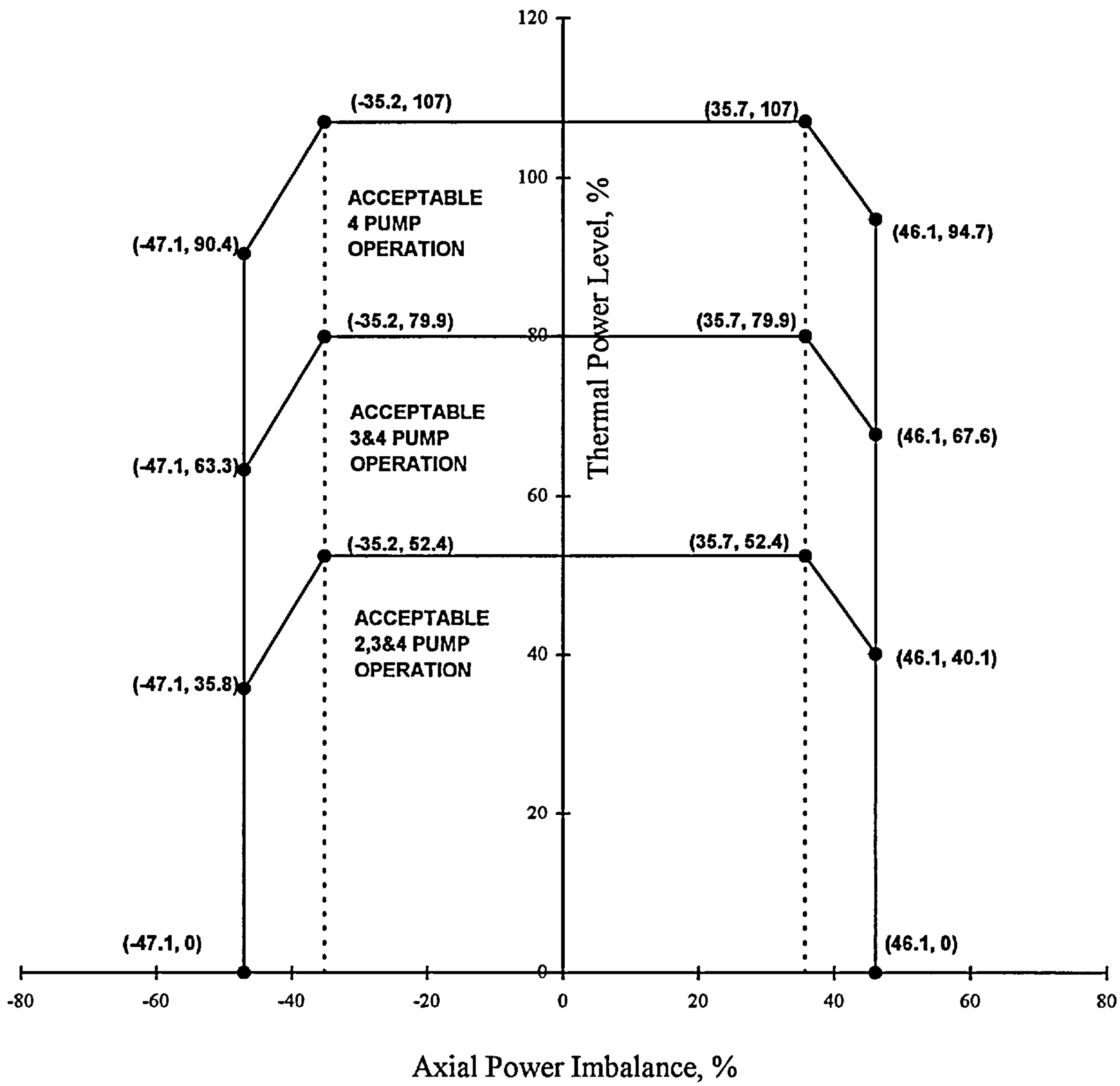
The present T-H methodology allows for an increase in the design radial-local peak for power levels under 100% full power. The equations defining the multipliers are as follows:

	$P/P_m = 1.00$	$P/P_m < 1.00$
MAP Multiplier	1.0	$1 + 0.3(1 - P/P_m)$

Where P = core power fraction, and
P_m = 1.00 for 4 pump operation, or
= 0.75 for 3-pump operation.

Figure is referred to by
Technical Specification 2.1.1.1, 2.1.1.2, and 3.3.1

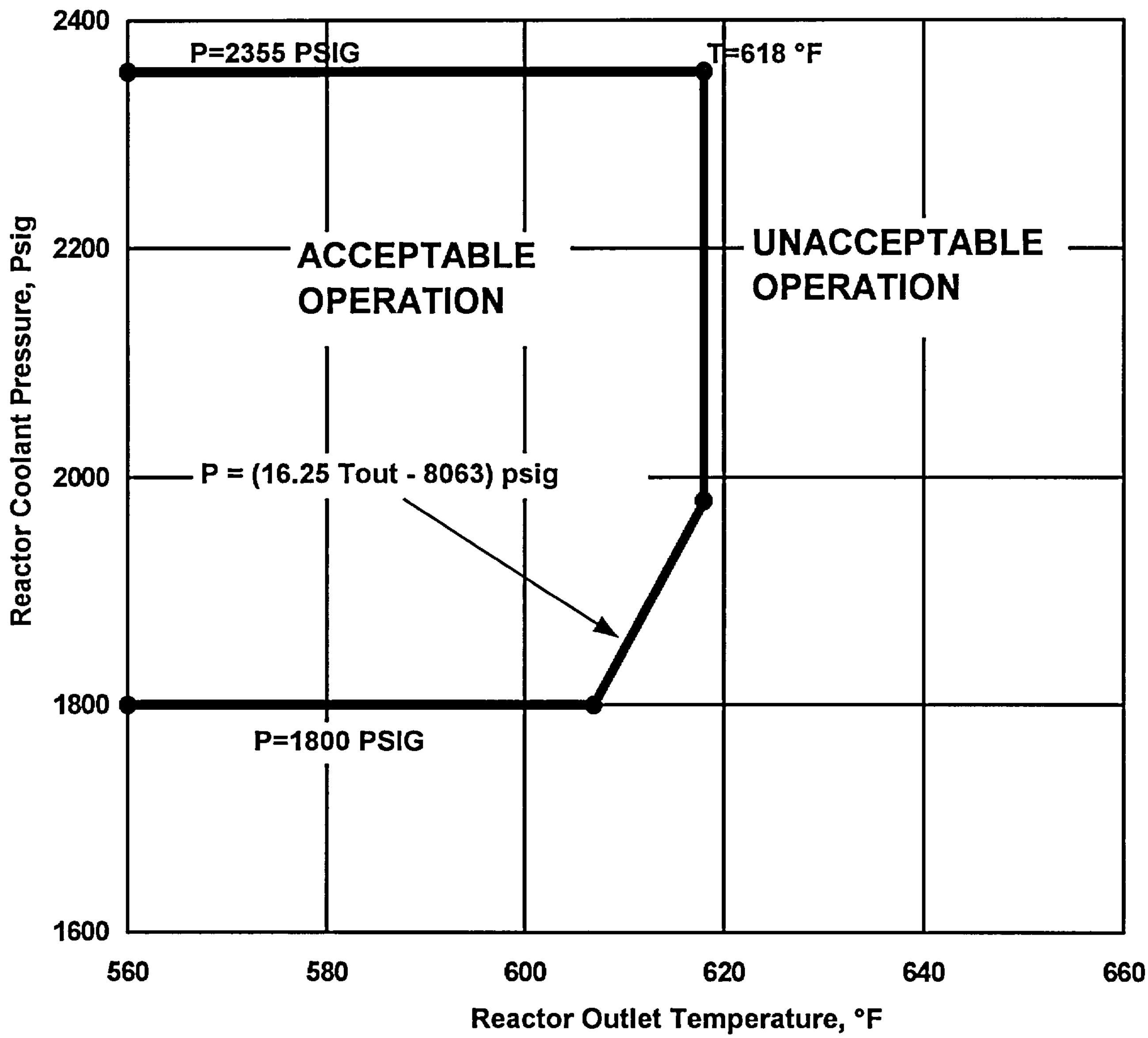
Figure 10. Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance



	Flux / Flow Setpoint (% Power / % Flow)
Four Pump Operation	1.07
Three Pump Operation	1.07
Two Pump Operation	1.07

Figure is referred to by
Technical Specification 3.3.1

Figure 11. Reactor Protection System Variable Low Pressure Temperature Envelope Setpoints



LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.4.1

RCS Pressure, Temperature, and Flow DNB Surveillance Limits

	Four-Pump Operation	Three-Pump Operation	Two-Pump Operation
Minimum RCS Hot Leg Pressure (psig) Note 1	2065.7	2063.9 Note 4 2100.9 Note 5	2099.1
Maximum RCS Hot Leg Temperature (°F) Note 2	603.45	603.55	604.00
Minimum RCS Total Flow (Mlb_m/hr) Note 3	138.10 Note 6 132.96 Note 9	103.36 Note 7 99.50 Note 9	68.06 Note 8 65.48 Note 9

Note 1 -- Using individual indications P1021, P1023, P1038 and P1039 (or equivalent) from the plant computer

Note 2 -- Using individual indications T1011NR, T1014NR, T1039NR, T1042NR, T1012, T1013, T1040 and T1041 or averages TOUTA, XTOUTA, TOUTB, XTOUTB, TOUT, XTOUT from the plant computer

Note 3 -- Using indication WRCFT (or equivalent) from the plant computer, and can be linearly interpolated between these values provided the T_{ave} versus Power level curve is followed.

Note 4 -- Applies to the RCS loop with two RCPs operating

Note 5 -- Applies to the RCS loop with one RCP operating.

Note 6 -- For Tcold = 555.79°F.

Note 7 -- For Tcold = 555 69°F.

Note 8 -- For Tcold = 555.31°F.

Note 9 -- For Tcold = 580°F.

LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.4.4

RCS Loops – Mode 1 and Mode 2

	Nominal Operating Power Level (% Power)
Four Pump Operation	100
Three Pump Operation	75
Two Pump Operation*	49

*Technical Specification 3.4.4 does not allow indefinite operation in Modes 1 and 2 with only two pumps operating.

LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.9.1

Refueling Boron Concentration

The minimum required boron concentration (which includes uncertainties) for use during refueling as a function of EFPD is:

EOC 17 EFPD	ppm
520	2433
522	2430
524	2427
526	2424
528	2421
530	2418
532	2415
534	2412
536	2409